

## NON-BLOCKING EXPANDABLE CALL CENTER ARCHITECTURE

### TECHNICAL FIELD

This invention relates to call centers, and in a more general sense, contact centers for 5 customer interface via telephone, and other media, with a plurality of agents at the contact center.

### BACKGROUND OF THE INVENTION

Most large corporations implement contact centers, an arrangement whereby customers may call in with questions regarding accounts, complaints, or other issues. A typical example of such a contact center might be a credit card company, which maintains a plurality of agents at one or more locations to handle customer inquiries, account questions, etc. Recently, these call centers may be more generally referred to as contact centers, since the agent customer interaction may not be limited to telephone calls. Rather, agent customer interaction may include items such as web chat, e-mail, or other forms of interaction between an agent and a customer.

Fig. 1 shows a conventional prior art legacy call center configuration. The arrangement includes a variety of distinct components that are usually patched together in order to provide the required services. The arrangement of Fig. 1 includes various reporting capabilities, different servers and gateways, and a variety of agents, all connected to a PBX. It also includes independent, disparate voice processing applications, such as voice mail and fax servers.

20 A variety of problems are present with respect to such prior art systems. First, the ability to grow the system is extremely limited. As more lines are required, more PBXs must be added. The PBXs must then be connected to all of the other PBXs. If four PBXs are to be used, for example, then each of the PBXs must be connected to three other PBXs. This creates a complicated system

which cannot be efficiently or easily expanded. The switching capacity of each PBX is used up largely to connect to other PBXs rather than to perform switching of contacts for servicing.

Another problem with such legacy prior art systems is that of fault tolerance, if fault tolerance is even available at all. Specifically, a typical manner in which fault tolerance is implemented at 5 such systems is to run a ghosting processor for every critical system. If a particular system element requires fault tolerance, then two of those elements must be run constantly, with one acting as a hot spare. This also causes a tremendous amount of excess cost to be introduced into the system.

*[Ce] [10] [15]*

Still another problem with prior art systems is that the switching capacity of the PBX is typically not enough to insure a non-blocking system. Specifically, in prior art systems, the main interface from the call center to the public switched telephone network (PSTN) is typically a PBX. The PBX is configured to have a switching capacity based upon the expected statistics regarding call volume and services requested. As a result, it is possible that an agent, voice mail, IVR or other system resource may be available, but a caller may nonetheless be blocked because the system has run out of switching capacity in order to connect the available resource to the caller. In such a situation, the caller is frustrated and the call center operator may lose business.

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In view of the above, there exists a need in the art for a more flexible and expandable call center architecture.

There also exists a need in the art for a call center which can provide back-up of critical resources without having to recreate every resource twice.

20 There also exists a need in the art for a system which can be easily expanded by adding resources without having to reconfigure the entire system.

## SUMMARY OF THE INVENTION

The above and other problems of the prior art are overcome in accordance with the present invention which relates to an easily expandable call center environment with fault tolerance. One or more ~~chassis~~ are utilized which each include switching capacity for connecting callers to a variety of call center resources. Additionally, each chassis contains one or more conference bridges for allowing call supervision, conferencing, etc. In the case of plural chassis, they are interconnected via a broadband network such as ATM, etc. One or more additional chassis is also provided for back-up of all other ~~chassis~~. If any of the plural chassis fails, the back-up may be utilized by rerouting calls through it to any other resource or agent in the call center.

10 Additionally, the chassis are interconnected in a manner that reserves bandwidth from the broadband network for such interconnection, rather than switching capacity of each chassis. Accordingly, the capacity of the call center is linearly expandable, and does not require the switching resources of the PBX in order to connect to other PBXs for expansion.

15 In an additional enhanced embodiment, the switching and resource platform may be configured in a hybrid manner that allows for a combination of narrowband/broadband operation. Specifically, the switching/resource platform may connect to call center agents partially through an existing PBX with permanent connections to the call center agents, and partially over a broadband communications network such as an Ethernet or ATM switch. By providing such hybrid operation, existing technology can be utilized and can be phased out as the system is grown and expanded. The 20 functionality implemented by connecting the agent stations to the switching and resource platform 210 is the same, irrespective of whether such connection is through the PBX 301 or LAN 208. The switching and resource platform 210 may be implemented as the CCPRO product, available from

the assignee of the present invention.

A more complete understanding of the present invention may be had by referring to the annexed drawings and following description of the invention.

## 5 BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 depicts a prior art legacy call center configuration;

Fig. 2 shows an exemplary configuration of the present invention wherein a switching arrangement is connected to various agents and servers via a broadband switching arrangement instead of a PBX; and

10 Fig. 3 depicts an environment in which a switching arrangement is connected to various agents through a PBX and to additional agents through a separate network such as a ATM or Ethernet.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Fig. 2 shows an exemplary arrangement for implementing the present invention in what is termed a broadband configuration. The arrangement of Fig. 2 includes one or more database servers 202 and application servers 203, agent stations 204 (only one of which is shown), and supervisory and management functions 205 and 206. The various computer systems are interconnected via a broadband communications network such as an Ethernet or ATM network 208. Any other type of network is possible as well. The incoming and outgoing contacts, both PSTN and Internet, are 20 handled by two CCPRO switches, each of which interfaces to the network 208 via interface 214 and 215, respectively. The CCPRO switches are available from the assignee of the present invention and

may operate in place of, or in conjunction with, a PBX. Each CCPRO switch is resident within one chassis, and includes plural boards to implement the switching capacity.

The particular chassis within which the switch 210 or 211 resides includes four potential points of interface for information to enter or exit the chassis. First, there are incoming trunks 5 (which may be Internet telephony or PSTN as shown), the number of which is denoted herein T.

Second, each switching chassis is responsible for handling a number S of agent stations, one of which is shown as 204. Third, the CCPRO switch chassis includes call processing resources of its own such as a conference bridge. Each resource might have to be connected to something else.

If R is the number of such other resources, this represents, worst case, R points of interface.

Finally, there are a number B of broadband connections reserved for connecting the chassis to other chassis such that switches 210 and 211 may communicate with one another. The number B represents only the broadband connections utilized to interconnect the switches, and does not include other communications over the broadband network.

The preferred strategy is to insure that there is enough switching capacity within the CCPRO chassis to insure that if any agent or other desired resource is available, a caller can be connected to that agent or resource. Moreover, the system should insure that the resources managed by and connected to any switch chassis 210, 211 or others can be used interchangeably by agents and callers connected to other chassis.

In order to insure such a technique, B, the number of connections used to interconnect the chassis to each other must be set at an appropriate level. Specifically, in the worst case scenario, every one of the trunks T and stations S may need to be simultaneously in communication via the broadband connections B to another chassis. This means in the worst case scenario,  $B \geq T + S$ .

Moreover, the switching arrangement is implemented within the chassis in a conventional fashion using time division multiplexing (TDM). It can be shown that in order to insure that no available connection is blocked because of lack of switching capacity, the number of time slots required within the switch is  $T + S + R + B$ , with resources R including conference, recording, and playback resources. By setting the time slots appropriately or, alternately, setting T, S, R, and B appropriately for a given number of timeslots, no blocking will occur and the system will be linearly expandable.

By linearly expandable we mean that the switching channels present in an added CCPRO switch chassis may all be utilized for call switching. This is in contrast to prior systems in which much of the switching capacity has to be utilized to interface to other PBXs, particularly as the number of PBXs increases.

Fig. 3 shows an additional embodiment of the present invention wherein like components have been labeled with similar numbers. The embodiment of Fig. 3 includes an additional component 301 which may be a legacy type of PBX.

As shown in Fig. 3, a plurality of connections to agent phones 303 and 304 may be connected to the CCPRO switch chassis 210 through the legacy PBX. This permits a company already utilizing a legacy call center architecture to add the CCPRO chassis without discarding their old equipment or redesigning their entire architecture.

In operation, the CCPRO switch would dial up the agents 303 and 304 through extensions on a PBX and leave such connections permanently in place. This dial up connection through the PBX is accomplished by having the CCPRO switch call the agent through the PBX in response to the agent logging into the CCPRO system. Notably, although only two agents are shown, many other blended agents may be connected to network 208 and may communicate with the switch not through

the PBX 301 but directly through the broadband network 208. Accordingly, a hybrid upgrade configuration is established whereby of a plurality of agents, several of the agents may communicate with the CCPRO switch via the PBX, and several may communicate with the switch via network

208. Ideally, the customer may begin utilizing the system by establishing all of the connections to

5 its agents through the PBX 301. As capacity expands and the PBX contains no further ports, further

*later - directly  
through LAN 208  
as capacity expands*

connections from the chassis 210 or other chassis 211, etc., may be done directly through the

broadband network 208. Alternatively, all contacts to and from the CCPRO switch, both inbound

and outbound and regardless of media type, may be completed by connecting agents through the

PBX on a permanent basis by having the CCPRO switch 210 dial up the agents through PBX 301.

10 All of the agent terminals may be connected to the CCPRO switch 210 notwithstanding the LAN 208

that interconnects the agent terminals and the CCPRO switch. The CCPRO switch would maintain

its connections to the agents while performing its telephony functions such as hold, transfer,

conference, record, and other similar voice processing functions.

An additional advantageous feature of the present architecture is the implementation of N+1 redundancy among call center switches. Specifically, Fig. 3 shows exemplary switches 210 and 211 in separate chassis. In actuality, the system is linearly growable so that capacity may be added simply by adding more trunks and more of such chassis 210 and 211.

Rather than constantly run a "hot spare," for each component, the system achieves redundancy and back-up in a manner that only requires one additional chassis and switch for all of 20 the switches running in the system. Specifically, an exemplary system may run five or six different CCPRO switches such as those depicted as 210 and 211. Since the system has reserved enough bandwidth for any switch to communicate with the agents and other resources of any other switch,

any of the CCPRO switches can service the capacity of any of the other ones. Accordingly, if there are five in the system, a sixth may be used as a hot spare to back-up any of the five operating switches which fails. In accordance with such a technique, if, for example, CCPRO switch 210 fails, 5 trunks destined originally for 210 to an additional and different N+1 redundant switch installed for the purpose of fault tolerance.

It is possible to use more back-up CCPRO switches (e.g., M) to obtain more reliable redundancy, but the  $N + M$  redundancy architecture eliminates the need for a hot spare with respect to each CCPRO switch. That is, M may be less than N, and the smaller M is, the less fault tolerance but the more savings, M could be one and still provide back-up.

10 While the foregoing describes the preferred embodiment of the invention, various modifications and/or additions will be apparent to those skill in the art. Such modifications are intended to be covered by the following claims.